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Multifunctional Radiation-Sensitive Paint Formulations for the Detection and Monitoring of Widespread Radioactive Contamination

J. Farmer, A. Rubenchik, C. Ebbers

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Multifunctional Radiation-Sensitive Paint Formulations for the Detection and Monitoring of Widespread Radioactive Contamination

Joseph C. Farmer, Alexander Rubenchik, and Chris Ebbers
Lawrence Livermore National Laboratory

Nuclear power plants, spent nuclear fuel storage pools, nuclear fuel processing plants, nuclear powered ships and terrorist threats all provide strong motivation for developing inexpensive technology to detect and monitor the spread of radioactive contamination over very large areas. Such technology would have been extremely beneficial during the recent Fukushima nuclear disaster in Japan, as it would have been during the infamous Chernobyl and Three Mile Island events. Similarly, the ability to monitor the widespread distribution of radioactive contamination during a possible terrorist attack with a dirty bomb, like the hypothetical events publicized following the 911 attack on the Twin Towers and Pentagon, all provide motivation for the development of such technology.

This motivation has led to the development of Lawrence Livermore National Laboratory's (LLNL's) patented paints and coatings that are capable of detecting widespread radiological agents in the environment (landscape, road signs, buildings, rooms, processing equipment, piping and pipelines, military vehicles, transportation containers, trucks, small unmanned aerial vehicles, balloons, and other relevant applications). This novel technology incorporates special radiation-sensitive pigments into an organic binder that can be applied as a paint or coating. These paints and coatings enable the detection of such radioactive sources and contaminants through scintillation of the inorganic or organic pigment, which is selected based upon the particle being detected (alpha, beta or gamma). Multifunctional paints can be formulated that enable the simultaneous detection of alpha, beta and gamma rays, with energy discrimination. Recent modifications of the formulation also enable neutron detection.

While simple scintillation pigments provide a means of instantaneous detection, the use of thermal (thermo) luminescent materials can provide an integral measurement of radiation exposure, with an historical record of any previous radiation exposure to which a particular coating may have been exposed. The ability of these new paint formulations to detect radiation was first demonstrated by using a Co-60 gamma source. Following irradiation, the paint sample was then heated with a hotplate, while the thermo-luminescent response was monitored with a digital camera, or in the case of lower doses, a photomultiplier tube. From the data obtained with these gamma-sensitive paints, the temperature threshold for interrogation was determined to be approximately 110-120ºC. The thermo-luminescent response was measured as a function of temperature following subsequent irradiations. From these data, the temperature threshold for interrogation of these gamma-sensitive paints appears to be slightly lower than following the initial irradiation, and stable at approximately 80-100ºC. Therefore, a new technical product has been developed and demonstrated, a paint capable of integrating a gamma dose and allowing interrogation upon heating to a modest temperature above ambient.

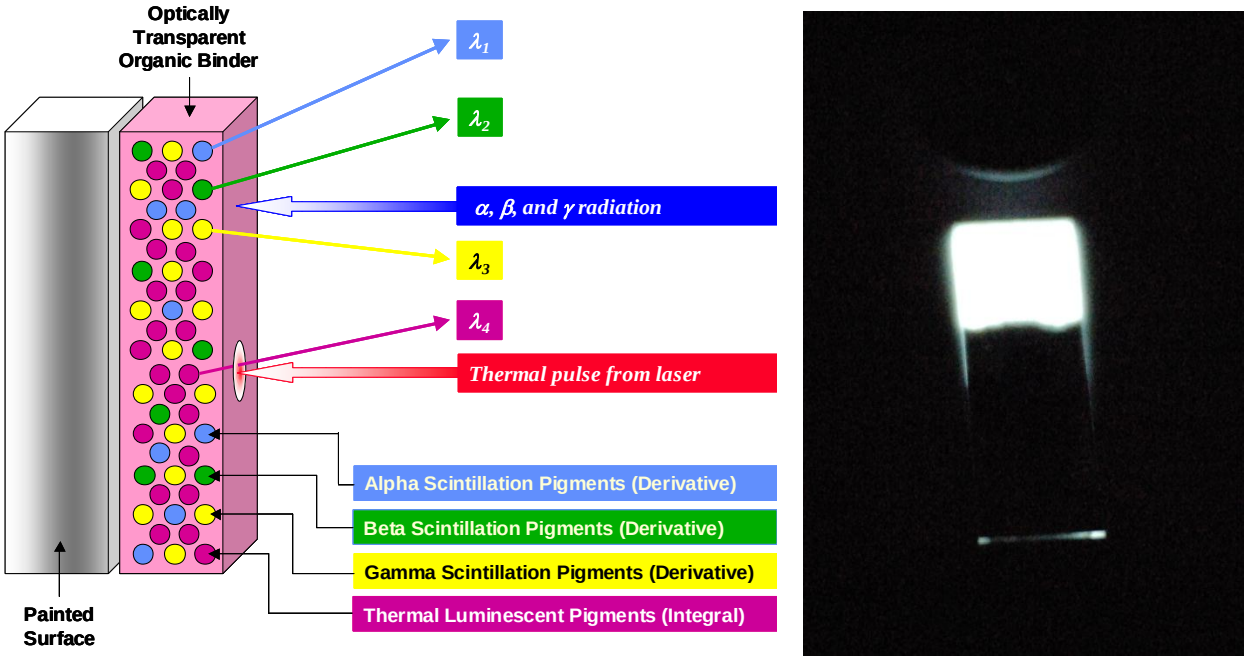

Figure 1 – Paint formulation with thermo-luminescent pigments and high-temperature refractive-index matched polymeric binder for the detection and monitoring of widespread radioactive contamination.

Disclaimer

Auspices Statement

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